PATENT
Attorney Docket 2316-6296

NOTICE OF EXPRESS MAILING

Express Mail Mailing Label Number: EV326918266US

Date of Deposit with USPS: January 27, 2004

Person making Deposit: Christopher Haughton

APPLICATION FOR LETTERS PATENT

for

CLOSURE ELEMENTS FOR TUBULAR MEMBERS AND CONTAINERS INCLUDING SAME

Inventors:
Michael J. Litchman

Attorneys:
Trent N. Butcher
Registration No. 51,518
Joseph A. Walkowski
Registration No. 28,765
TRASKBRITT
P.O. Box 2550
Salt Lake City, Utah 84110
(801) 532-1922

CLOSURE ELEMENT FOR TUBULAR MEMBERS

BACKGROUND OF THE INVENTION

[0001] Field of the Invention: The present invention relates generally to containers storing, carrying, and shipping items disposed therein. More particularly, the present invention relates to a closure element for closure of an end of a tubular member wherein the closure element is configured to interlock with the tubular member and containers including same.

[0002] State of the Art: Tubular members have been prevalently used for many years in a variety of applications. In general, tubular members have been used as containers for shipping, storing, and carrying various items. As such, it is typically desirable to close both ends of the tubular member to form a closed container therein. Furthermore, it may be desirable to selectively open and close the container more than one time. Thus, it would be beneficial for an end closure device of a tubular member to be easily installed and removed, while also providing secure closure.

[0003] Accordingly, conventional closure devices have been developed that interlock with the tubular member in some way. In one configuration, conventional closure devices may fit about the exterior of a tubular member. For instance, U.S. Patent No. 3,856,199 to Gartz discloses a cap for sealing a container wherein the cap has a wall portion in overlapping relationship with a wall portion of the container. In addition, U.S. Patent No. 3,599,821 to Eggert et al. discloses a closure device of plastic which is pressed onto the open end of a container and includes one or more locking projections which snap into an inner annular groove in the container wall. Further, U.S. Patent No. 3,913,774 to Vajtay discloses a cap including engaging means for insertion within perforations formed in the tubular member. However, closure devices which are disposed about the periphery of the tubular member may be subject to damage by exposure to impacts and the like.

[0004] On the other hand, some conventional closure apparatus are designed to fit, at least partially, within the bore of a tubular member. For instance, U.S. Patent No. 4,046,168 to Milne, U.S. Patent No. 2,737,205 to Stringfield, and U.S. Patent No. 3,078,879 to Mallard disclose examples of closure devices that fit at least partially within the bore of a tubular member. Further, U.S. Patent No. 3,986,659 to Vajtay discloses an end plug for closure of a tube

wherein the end plug includes radial protrusions that fit into perforations formed within the tubular member and a rim on which the tubular member is seated.

[0005] As may be appreciated, it would be advantageous to provide a tubular member closure element that is substantially protected from damage when installed within a tubular member, provides considerable resistance to unintended removal while installed, and enables installation and removal with relative ease.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention relates to closure elements and containers including same. More particularly, a closure element of the present invention may be used for substantially closing an end of a tubular member. A closure element may include a base that is sized and configured to substantially close a bore of a tubular member within which it is disposed. Further, a closure element of the present invention may include at least one engagement feature configured to be movable between at least a first position and at least a second position.

[0007] In addition, the at least one engagement feature of the closure element may be sized and configured to cooperatively engage an associated wall structure of a wall of the tubular member when it occupies the first position and disengage from the associated wall structure of the wall structure of the tubular member when it occupies the second position.

[0008] In one embodiment, the at least one engagement feature may be configured as at least one outwardly extending radial protrusion, while the at least one associated wall structure may be configured as an aperture formed in the wall of the tubular member. In a second embodiment, the at least one engagement feature may be configured as at least one aperture and the at least one associated wall structure may be configured as at least one radial protrusion extending inwardly from the wall of the tubular member.

[0009] The closure element may further include a movable structure corresponding to each of the at least one engagement features of the closure element, wherein each movable structure is configured to facilitate movement of an associated engagement feature between the at least a first position and the at least a second position.

[0010] In other aspects of a closure element of the present invention, at least one of a locking structure and a biasing element may be configured for influencing the movement or

position of the at least one movable structures. Also, the closure element may be sized and configured to fit substantially within the bore of a tubular member, or alternatively, to fit entirely within the bore of a tubular member.

[0011] Thus, the present invention also contemplates that at least one of any of the above-mentioned closure elements may be assembled to a tubular member to form a container. Accordingly, a container according to the present invention may include a tubular member having an outer surface and an inner surface defining a wall therebetween, wherein the inner surface defines a bore and the bore extends between a first end and a second end of the tubular member. Further, the tubular member may also include at least one wall structure formed generally on the wall of the tubular member.

[0012] A first and, optionally, a second closure element according to the present invention may be installed within the bore of the tubular member to form a container. Put another way, at least one closure element of the present invention may be assembled to a tubular member to form a container according to the present invention.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0013] The foregoing and other advantages of the present invention will become apparent upon review of the following detailed description and drawings in which:

[0014] FIG. 1A shows a perspective view of an exemplary closure element of the present invention;

[0015] FIG. 1B shows a side cross-sectional view of the exemplary closure element shown in FIG. 1A;

[0016] FIG. 1C shows a top elevation view of the exemplary closure element shown in FIGS. 1A and 1B;

[0017] FIG. 2 shows a perspective view of an exemplary tubular member of the present invention;

[0018] FIG. 3A shows a perspective view of a container including the exemplary closure element shown in FIGS. 1A-1C disposed within the exemplary tubular member shown in FIG. 2;

[0019] FIG. 3B shows an enlarged partial cross-sectional view of the container shown in FIG. 3A;

[0020] FIG. 3C shows an enlarged partial cross-sectional view of the exemplary closure element shown in FIGS. 1A-1C disposed within the exemplary tubular member shown in FIG. 2 and being engaged or disengaged therewith;

[0021] FIG. 4A shows a perspective view of another exemplary closure element of the present invention;

[0022] FIG. 4B shows a side cross-sectional view of the exemplary closure element shown in FIG. 4A;

[0023] FIG. 5A shows a perspective view of a further exemplary closure element of the present invention;

[0024] FIG. 5B shows a side cross-sectional view of the exemplary closure element shown in FIG. 5A;

[0025] FIG. 5C shows a perspective view of another exemplary tubular member of the present invention;

[0026] FIG. 5D shows a perspective view of a container including the exemplary closure element shown in FIGS. 5A-5B disposed within the exemplary tubular member shown in FIG. 5C;

[0027] FIG. 5E shows an enlarged partial cross-sectional view of the container shown in FIG. 5D;

[0028] FIG. 5F shows an enlarged partial cross-sectional view of the exemplary closure element shown in FIGS. 5A-5B disposed within the exemplary tubular member shown in FIG. 5C and being engaged or disengaged therewith;

[0029] FIG. 6A shows a top elevation view of the closure element shown in FIGS. 1A-1C including a locking element; and

[0030] FIG. 6B a top elevation view of the closure element shown in FIGS. 1A-1C including a biasing element.

DETAILED DESCRIPTION OF THE INVENTION

[0031] The present invention comprises a closure element sized and configured to fit at least partially within the bore of a tubular member. Thus, while the embodiments illustrated and described herein may be specific, with respect to the illustrated geometries, it should be recognized that the present invention is not limited to the particular embodiments or configurations described herein, but, rather, other suitable geometries may be used. Furthermore, as one of ordinary skill in the art will recognize, there are combinations of and alterations to the embodiments described herein that are encompassed by the present invention.

[0032] Turning to FIGS. 1A-1C, FIG. 1A shows a perspective view of a closure element 10 of the present invention, FIG. 1B shows a side cross-sectional view of closure element 10, and FIG. 1C shows a top elevation view of closure element 10. Closure element 10 generally comprises a radially extending base 16 from which side walls 12 longitudinally extend, forming end surface 15. Side walls 12 may be shaped so as to substantially close a bore of a tubular member as described hereinbelow. Accordingly, the body of the closure element 10 may have a radial periphery that substantially fits within or conforms to the bore of an associated tubular member. Thus, the radial outer surfaces of side walls 12 may be semi-circular, as shown in FIGS. 1A and 1C, or may comprise other shapes corresponding to an associated tubular member bore such as: generally rectangular, generally triangular, or otherwise generally polygonal.

[0033] In addition, movable structures 20 may extend longitudinally from base 16 by way of attachment walls 24, respectively. Movable structures 20 may be circumferentially positioned about the periphery of closure element 10 symmetrically or asymmetrically. Thus, as shown in FIGS. 1A-1C, movable structures 20 may be positioned substantially circumferentially opposite one another, or, put another way, circumferentially separated by about 180°. Each of movable structures 20 may comprise depression 25 formed by a surrounding wall 21 and lower wall 33 (FIG. 1B), respectively. The radially outer portion of each surrounding walls 21 may exhibit a substantially congruent or conformal shape as the bore of a tubular member within which it is to be disposed. For instance, the radially outer portion of each of surrounding walls 21 may have a radius of curvature substantially equal to that of side walls 12 and may be concentric in relation thereto. Also, apertures 32 may be formed through the radially inner

portion of each of surrounding walls 21, thus forming upper radially inner sections 30 of each of surrounding walls 21.

[0034] Each of movable structures 20 may further comprise engagement feature 22, comprising an outwardly radially extending protrusion and corresponding recess 23 formed proximate thereto and complementary therewith, respectively. Engagement structures 22 may be sized and configured for insertion within a bore of a tubular member. Particularly, engagement structures 22 may comprise tapered surface 34, which may facilitate forcing of closure element 10 within or removing closure element 10 from a bore of a tubular member that is sized substantially identically to the outer radial surfaces of side walls 12. Further, engagement structures 22 may each include a radially extending lip 35, which may be configured to abut against a wall structure of the tubular member.

[0035] Closure element 10 may comprise a metal or plastic. Due to the relatively complex geometry of closure element 10, it may be preferred to form closure element 10 by molding or casting. For instance, closure element 10 may be formed of thermoplastic, as by injection molding. Alternatively, closure element 10 may be formed of a metal as by die casting or investment casting.

[0036] FIG. 2 shows a tubular member 50 according to the present invention in a perspective view. Tubular member 50 includes outer surface 52 and inner surface 54, which forms bore 58, bore 58 extending between longitudinal ends 56 and 57. Proximate to each of longitudinal ends 56 and 57 tubular member 50 further includes wall structures 60, each of which comprises an aperture extending from outer surface 52 of tubular member 50 to inner surface 54 of tubular member 50. Wall structures 60 may be formed by punching, machining, or as otherwise known in the art.

[0037] As shown in FIG. 2, tubular member 50 may be substantially cylindrical. Alternatively, tubular member 50 may be generally rectangular, generally square, generally triangular, or otherwise polygonal (hexagonal, octagonal, etc.) without limitation. Further, tubular member 50 may have a substantially constant cross-section along its longitudinal length, or, alternatively, the cross-sectional shape may vary. In the case of a constant cross-sectional shape, tubular member 50 may comprise an extruded material such as metal or plastic.

Alternatively, tubular member 50 may be formed by a rolling process or as otherwise known in the art and may comprise cardboard or paper material, without limitation.

[0038] FIG. 3A shows a perspective view of container 51, which includes closure elements 10 disposed within the bore 58 of tubular member 50 proximate to ends 56 and 57 thereof, respectively. As may be appreciated, closure elements 10 may be sized and configured to substantially close bore 58 of a tubular member 50, as shown in FIG. 3A, by positioning closure elements 10 substantially therein, proximate each of ends 56 and 57, respectively. Thus, the outer radial surfaces of side walls 12 of closure elements 10 may be sized and shaped to substantially conform to the inner surface 54 of tubular member 50.

[0039] More specifically, bases 16 of closure elements 10 each may extend substantially transversely in relation to bore 58, but may be positioned longitudinally therein, at a distance from each of ends 56 and 57, respectively. Thus, closure elements 10 may substantially close bore 58 at a longitudinal position located therein. As shown in FIG. 3A, end 15 of closure element 10 may be substantially longitudinally aligned with end 56 of tubular member 50. Accordingly, closure elements 10 may substantially fit within the longitudinal extent of tubular member 50. Preferably, closure elements 10 may entirely fit within the bore 58 of tubular member 50. Such a configuration may protect closure elements 10 from damage.

[0040] Engagement features 22 of closure elements 10 may each be sized and configured to cooperatively engage, respectively, a corresponding wall structure 60 of tubular member 50 so as to retain, lock, position, or affix the closure elements 10 in relation thereto. For instance, a respective engagement feature 22 may cooperatively engage by fitting within an associated wall structure 60 so as to radially interfere or overlap with one another. Put another way, associated engagement features 22 and wall structures 60 may occupy at least a common radial position. Such a configuration may provide a closure for tubular member 50 that is relatively resistant to removal of closure element 10 when engagement features 22 are disposed within wall structures 60, respectively.

[0041] Further, the outermost radial surfaces of surrounding walls 21 of movable structures 20 of closure elements 10 may also be sized and shaped to substantially conform to the inner surface 54 of tubular member 50. Such a configuration may be particularly advantageous, because once engagement features 22 engage associated wall structures 60, longitudinal force

applied to closure element 10 may tend to cause interference between the outermost radial surfaces of the surrounding walls 21 of a closure element 10 and the inner surface 54 of the tubular member 50. Such interference may tend to lock the closure element 10 against the bore of the tubular member 50. Accordingly, such interference may be described as a self-locking mechanism which impedes unintended removal of a closure element 10 from tubular member 50.

[0042] Accordingly, movement of movable structures 20 may, in turn, cause movement of respective engagement features 22. Thus, engagement features 22 may be configured to move radially, longitudinally, or a combination thereof. For instance, engagement features 22 may bend or rotate in relation to base 16, may be biased or displaced radially or longitudinally, or may be moved in any combination thereof.

[0043] Movable structures 20 may be independently moved or displaced by application of force thereto, respectively. For instance, movement of movable structures 20 may be caused by application of force to each upper radial inner section 30 thereof. Depending on the size and configuration of attachment walls 24, the magnitude of force necessary to displace either or both of movable structures 20 may vary. Bending of attachment walls 24, respectively, may preferably be resilient (i.e., without substantial permanent deformation), so that engagement feature 22 may be positioned so as to cooperatively engage wall structure 60 and disengage therefrom, with the movable structure returning, in the absence of force applied thereto, generally to the position and configuration depicted in FIGS. 1A-1C.

[0044] For instance, attachment walls 24 may be sized and configured so that a person's finger, thumb, or combinations thereof may be used to apply a force to movable structures 20 by placing a finger into one depression 25 and placing a thumb into the other depression 25 and squeezing the movable structures 20 toward one another.

[0045] FIG. 3B shows an enlarged partial cross-sectional view of container 51, showing closure element 10 disposed within bore 58 and engagement feature 22 disposed within wall structure 60. Thus, in the position depicted in FIG. 3B, engagement feature 22 cooperatively engages wall structure 60 in a radially interfering relationship so as to position closure element 10 with respect to tubular member 50. Particularly, as shown in FIG. 3B, engagement lip 35 may abut against the boundary wall defining the aperture that comprises wall

structure 60. In such a position, engagement feature 22 may substantially inhibit the range of movement of closure element 10 within bore 58 of tubular member 50.

[0046] FIG. 3C shows an enlarged partial cross-sectional view of container 51, which shows closure element 10 disposed within bore 58 of tubular member 50 wherein engagement feature 22 is positioned so as to facilitate or allow movement of closure element 10 within bore 58 of tubular member 50. Such an arrangement may occur when placing closure element 10 within bore 58 or when removing closure element 10 from bore 58. For instance, a force, labeled F may be applied to upper radially inner section 30 of surrounding wall 21 to cause attachment wall 24 to bend, as shown in FIG. 3C. Such a position of engagement feature 22 may facilitate movement of closure element 10 within bore 58 of tubular member 50, since radial interference with wall structure 60 no longer exists. Force F may be generally oriented radially inwardly, depending on the configurations of movable structure 20, closure element 10, and the mechanical properties of each. Also, other forces (not shown) in other orientations may be applied to moveable structure 20, in accordance to the desired movement of closure element 10.

[0047] Therefore, engagement features 22 may be movable between at least a first position and at least a second position, wherein the first position of engagement features 22 inhibits movement of closure element 10 with respect to tubular member 50 (i.e., radial interference exists between engagement feature 22 and wall structure 60), while the second position facilitates movement of closure element 10 with respect to tubular member 50 (i.e., there is not radial interference between engagement feature 22 and wall structure 60). Of course, it is recognized that a frictional force may develop between the engagement features 22 of closure element 10 and the inner surface 54 of tubular member 50 even while engagement features 22 occupy the second position. However, frictional forces developed between the engagement features 22 of closure element 10 and the inner surface 54 of tubular member 50 may be relatively small in magnitude in comparison to the magnitude of force that would be required to move closure element 10 when the engagement features 22 occupy the first position and cooperatively engage wall structures 60, respectively.

[0048] While the above-described embodiment depicts wall structures 60 as comprising apertures, the present invention is not so limited. Wall structures 60 may comprise annular grooves, individual recesses, or even inwardly extending radial protrusions, as discussed

hereinbelow. Further, the number of engagement features and corresponding wall structures are not limited to two, and may comprise one or three or more.

[0049] It is also recognized that a container of the present invention may be formed by a tubular member and at least one closure element according to the present invention. Explaining further, in some instances, a container having one open end may be desirable. Alternatively, one end of a container of the present invention may be closed by a different type of closure element and one end of the container may be closed by a closure element 10 of the present invention. Accordingly, a container of the present invention may be formed by a tubular member in combination with at least one closure element of the present invention, without limitation. On the other hand, in a further embodiment, a substantially closed container may be formed by the assembly of two closure elements of the present invention into respective ends of a tubular member, as described above in relation to container 51.

[0050] The present invention contemplates, generally, that at least one engagement feature may be positioned along the periphery of a closure element, without limitation. For instance, FIGS. 4A and 4B show closure element 110, in perspective and side cross-sectional views, respectively, including a radially extending base 116 from which side walls 112 longitudinally extend as well as engagement feature 122 disposed in mechanical communication with movable structure 120. Movable structure 120 may be configured for applying, transmitting, or communicating a generally radially inwardly directed force to engagement feature 122 so as to bias or displace engagement feature 122 so as to disengage engagement feature 122 from a corresponding wall structure(not shown).

[0051] For instance, if the attachment wall 123 is sufficiently flexible, a person's finger or thumb may be disposed within aperture 121 in order to displace engagement feature 122. Two closure elements 110 may be installed within the bore 58 of tubular member 50, proximate to ends 56 and 57 to form a container similar to container 51 described hereinabove.

[0052] Thus, more generally, and conceptually, a closure element of the present invention may include a finger cup sized and configured for accepting a finger of a person therein. More specifically, a finger cup may be configured as depression 25 of closure element 10 or as aperture 120 of closure element 110. In addition, an engagement feature of the present invention may be resiliently cantilevered in relation to the base that carries it. More particularly,

engagement features 20 are cantilevered in relationship to the base 16 by way of attachment walls 24. Similarly, engagement feature 122 is cantilevered in relationship to base 116 by way of attachment wall 123. In such a configuration, the attachment walls 24 or 123 may be characterized as a leaf spring that mechanically affixes the engagement feature 22 and 122 to the base 16 and 116, respectively. Thus, the cantilevered relationship between an engagement feature and a base carrying same may be resilient.

[0053] Therefore, generally, the present invention contemplates a closure element may include at least one engagement feature which is movable between at least a first position and at least a second position, wherein the at least a first position of the engagement feature inhibits movement of the closure element with respect to tubular member, while the at least a second position facilitates movement of the closure element with respect to the tubular member.

[0054] Alternatively, it may be desirable to include more than one engagement feature upon a closure element for additional stability or strength. In addition, it may be advantageous to include two engagement features because movement of the engagement features may be accomplished by a person's finger and opposable thumb. Further, two or more movable structures may be preferable because their configuration may allow for ease in holding, handling, and positioning closure element into and out of a bore of a tubular member.

[0055] In another embodiment of a closure element and container containing same according to the present invention, an engagement feature of a closure element may comprise an aperture, while the wall structure of a tubular member may comprise an inwardly extending radial protrusion. Further, the engagement structure of the closure element may be sized, positioned, and configured to cooperatively engage a wall feature formed in the wall of a tubular member. Such a configuration may provide an arrangement that may affix, retain, or position a closure element that is assembled within a bore of a tubular member. More particularly, FIG. 5A shows a perspective view of closure element 210, comprising a radially extending base 216 having generally semi-circular side walls 212 longitudinally extending therefrom. Further, FIG. 5B shows a side cross-sectional view of closure element 210.

[0056] As shown in FIGS. 5A and 5B, movable structures 220 may extend longitudinally from base 216, attached thereto by way of attachment walls 224, respectively. Movable structures 220 may be positioned substantially circumferentially opposite one another,

i.e., circumferentially separated by approximately 180°. Each of movable structures 220 may comprise depression 225 formed by a surrounding wall 221 and lower wall 233 (FIG. 5B), respectively. The outer radial portion of each of surrounding walls 221 may exhibit a substantially congruent or conformal shape as the bore of a tubular member within which it is to be disposed. For instance, the outer radial portion of each of surrounding walls 221 may exhibit a radius of curvature substantially equal to that of side walls 212 and may be concentric in relation thereto. Also, aperture 232 may be formed through the radially inner portion of each of surrounding walls 221, thus forming upper radially inner sections 230 of each of surrounding walls 221. Further, each of movable structures 220 may further comprise an engagement feature 222, which comprises an aperture formed through surrounding walls 221, respectively.

[0057] Thus, closure element 210 may be configured to substantially close the bore of a tubular member when disposed therein. For instance, FIG. 5C shows such a tubular member 250 of the present invention in a perspective view. Tubular member 250 includes outer surface 252 and inner surface 254, the inner surface forming bore 258, which extends between longitudinal ends 256 and 257. Tubular member 250 may also include wall structures 260, proximate to longitudinal ends 256 and 258, wherein each wall structure 260 comprises a radially inwardly extending protrusion. Wall structures 260 may be formed by punching, bending, or as otherwise known in the art. As discussed above, tubular member 250 may comprise an extruded material or a rolled material. For instance, tubular member 250 may comprise aluminum, steel, plastic, cardboard, or paper.

[0058] Container 251, shown in FIG. 5D, depicts closure elements 210 assembled to each end of tubular member 250, wherein closure elements 210 are disposed within bore 258 thereof proximate to end 256 and end 257, respectively. As may be appreciated, closure element 210 may be sized and configured to substantially close bore 258 of tubular member 250 to form a substantially closed volume therein. More particularly, bases 216 of closure elements 210 may each extend substantially transverse to bore 258, but may be positioned longitudinally therein, at a distance from ends 256 and 257, respectively. Accordingly, closure elements 210 may substantially fit within the longitudinal extent of tubular member 250. Preferably, closure elements 210 may entirely fit within the bore 258 of tubular member 250. Such a configuration may protect closure elements 210 from damage.

[0059] Also, the outer radial surfaces of side walls 212 of closure elements 210 may be sized and shaped to substantially conform to bore 258 of tubular member 250. Further, the outermost radial portions of surrounding walls 221 of movable structure 220 of closure elements 210 may also be sized and shaped to substantially conform to the bore 258 of tubular member 250.

[0060] Each of engagement features 222 of closure elements 210 may be configured to cooperatively engage, respectively, a corresponding wall structure 260 of tubular member 250 so as to retain, lock, position, or affix the closure element 210 in relation thereto. Explaining further, an engagement feature 222 may receive at least a portion of a radially inwardly extending protrusion comprising wall structure 260 so as to radially interfere or overlap with one another. In other words, corresponding engagement features 222 and wall structures 260 may occupy at least a common radial position.

[0061] Particularly, FIG. 5E shows an enlarged partial cross-sectional view of container 251, showing closure element 210 disposed within bore 258 proximate to end 256 wherein engagement feature 222 engages or surrounds wall structure 260. In the position depicted in FIG. 5E, engagement feature 222 accepts or receives wall structure 260 in a radially interfering relationship so as to position closure element 210 with respect to tubular member 250. In such a position, engagement feature 222 may substantially inhibit the range of movement of closure element 210 within bore 258 of tubular member 250.

[0062] In order to position closure element 210 within bore 258 of tubular member 250 and remove closure element 210 therefrom, movable structures 220 may be moved or displaced at least temporarily. Further, such movement of movable structures 220 may cause movement of respective engagement features 222. Thus, engagement features 222 may be configured to be displaced radially, longitudinally, or a combination thereof. For instance, engagement features 222 may bend, displace, deform, or rotate in relation to base 216, or may be biased radially or longitudinally, or moved according to any combination thereof so as to disengage associated wall structures 260.

[0063] More specifically, FIG. 5F shows an enlarged partial cross-sectional view of container 251, which shows closure element 210 disposed within bore 258 of tubular member 250 wherein engagement feature 222 is positioned so as to facilitate movement of closure

element 210 within bore 258 of tubular member 250. Particularly, a force, labeled F, may be applied to upper radially inner section 230 of surrounding wall 221 that causes attachment wall 224 to bend. Such a position of engagement feature 222 may facilitate movement of closure element 210 within bore 258 of tubular member 250. Force F may be generally oriented radially inwardly, or as otherwise may be effective to displace engagement feature 222 so as to disengage from wall structure 260.

[0064] Furthermore, as in designing a closure element of the present invention, attachment walls 224 may be sized and configured to selectively adjust or determine the magnitude of force necessary to displace either or both of movable structures 220. It may be advantageous to select dimensions and mechanical properties of attachment walls 224 such that a person's finger, thumb, or combinations thereof may be used to displace movable structures 220 by placing a finger into one depression 225 and placing a thumb into the other depression 225 and squeezing the movable structures 220 toward one another.

[0065] In yet another aspect of the present invention, it may be desirable to include other structures that influence the movement of or position of movable structures of a closure element. For instance, FIGS. 6A and 6B show, respectively, a top elevation view and a side cross-sectional view of the closure element 10 shown in FIGS. 1A-1C, including locking structure 46 disposed between the inner radial portions of surrounding walls 21 of each of movable structures 20. More specifically, ends 48 of locking structure 46 may engage or fit into apertures 32 (FIGS. 1A and 1B) of movable structures 20. Locking structure 46 may resist radially inward movement of movable structures 20, or, alternatively, may displace movable structures 20 radially outwardly, according to the size of locking element 46 in relation to the available space between movable structures 20. Such a configuration may allow for the movable structures 20 to be relatively easily moved and, therefore, closure element 10 to be easily installed within and removed from a bore of a tubular member. On the other hand, easy movement of movable structure 20 may facilitate unintended or inadvertent disengagement of engagement structure 22 thereon, which may further cause removal of closure element from a bore of a tubular member. However, upon installation of locking structure 46, locking structure 46 may substantially inhibit inadvertent removal of closure element 10 from a bore of a tubular member.

[0066] Also, in a further aspect of the present invention, FIGS. 6C and 6D show, respectively, a top elevation view and a side cross-sectional view of the closure element 10 shown in FIGS. 1A-1C, including biasing element 44 disposed between end structures 47, wherein the end structures 47 engage or fit into apertures 32 (FIGS. 1A and 1B) of surrounding walls 21 of each of movable structures 20. Biasing element 44, which may comprise a compression spring, may be configured to bias against radially inward movement of movable structures 20, or, alternatively, may bias movable structures 20 radially outwardly, according to the configuration of biasing element 44 in relation to the available space between movable structures 20. Such a configuration may substantially inhibit inadvertent removal of closure element 10 from a bore of a tubular member, as described hereinabove in relation to locking structure 46.

[0067] Although specific embodiments have been shown by way of example in the drawings and have been described in detail herein, the invention may be susceptible to various modifications, combinations, and alternative forms. Therefore, it should be understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the invention includes all modifications, equivalents, combinations, and alternatives falling within the spirit and scope of the invention as defined by the following appended claims.